COSEWIC
Assessment and Update Status Report

on the

Ancient Murrelet
Synthliboramphus antiquus

in Canada

SPECIAL CONCERN
2004

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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COSEWIC
Assessment Summary

Assessment Summary – November 2004

Common name
Ancient Murrelet

Scientific name
Synthliboramphus antiquus

Status
Special Concern

Reason for designation
This burrow-nesting seabird is impacted by mammalian predators that have been introduced to its breeding islands. Predators have been removed from some islands but populations have not increased as a result. About half of the world population nests in the Queen Charlotte Islands, British Columbia; the Canadian population is thought to be declining.

Occurrence
British Columbia

Status history
Designated Special Concern in April 1993. Status re-examined and confirmed in November 2004. Last assessment based on an update status report.

COSEWIC
Executive Summary

Ancient Murrelet
Synthliboramphus antiquus

Species information

The Ancient Murrelet, *Synthliboramphus antiquus*, is a seabird in the Alcidae, or auk family. It is most closely related to the Japanese Murrelet, *S. wumizusume*, but also to two other birds in North America: Xantus's Murrelet, *S. hypoleucus* and Craveri's Murrelet, *S. craveri*. Ancient Murrelets are about 25 cm long and are grey-bodied with a white throat and cheek, black chin and crown, and a yellow-tipped bill. In breeding plumage they have a distinctive line of white feathers extending back from the eye and fine black-and-white lines on the sides of the nape.

Distribution

The Ancient Murrelet breeds from the Sea of Japan to the Queen Charlotte Islands of British Columbia. There are potentially still birds in China, Korea and Japan, but their numbers are unknown, as the colonies are not surveyed on a regular basis. There are two large colonies in the northern Sea of Okhotsk in Russia. In Alaska, Ancient Murrelets breed on the Aleutian chain, the Alaskan Peninsula and the Gulf of Alaska. In Canada, they breed exclusively on small islands in the Queen Charlotte Archipelago.

Habitat

Ancient Murrelets breed on islands in areas that are at least 300 to 400 m from shore. They prefer to nest in forested areas, but will use treeless islands if forested ones are not available. They dig their burrows wherever there is sufficient soil depth, generally near trees or other objects for protection.

Biology

The Ancient Murrelet is a diving seabird that eats zooplankton and fish. They breed at 3 or 4 years of age, laying 2 eggs in April at a colonial breeding site. Chicks leave the nest with their parents when they are a few days old without ever having been fed. They spend the next month at sea, where their parents feed them until they are full-grown. Birds spend most of the year away from the Queen Charlotte Islands. They do not always return to the same colony where they were born.

Population sizes and trends

There are an estimated 256,000 pairs (about half the world population) of Ancient Murrelets nesting on 31 colonies in the Queen Charlotte Islands. Only eleven colonies have been surveyed between 1993 and 2004: Reef, Frederick and George showed an increase in number of birds, Lihou and Saunders appear stable, while the numbers on Limestone, Helgesen and Kunghit have decreased, with the population on Kunghit now believed to be extirpated. Populations on Langara and Rankine showed no statistical trend, with Langara showing no signs of recovery after rat extermination. Populations on predator-free islands are increasing by 0.2 – 9.5% annually; populations on islands with introduced mammalian predators are decreasing dramatically (up to 23% annually). Overall, the total population is likely decreasing; data from colonies with censuses in both the 1980s and 1990s show an approximate 18% decline between those decades.

Limiting factors and threats

The main factor threatening Ancient Murrelet populations around the world is introduced mammals: rats in Asia, foxes in Alaska, and rats and raccoons in British Columbia. Other risks to the Ancient Murrelet include disturbance, oil exploration, oceanographic changes and commercial fisheries.

Special significance of the species

The Queen Charlotte Islands are home to 50% of the world's population of Ancient Murrelets. The Ancient Murrelet is the most numerous member of its genus. Its closest relative, the Japanese Murrelet, is severely endangered.

Existing protection or other status designations

The Ancient Murrelet, including its eggs and nest, is protected in Canada under the *Migratory Birds Convention Act (1994)*, the *Canada National Marine Conservation Areas Act (2002)* and the *BC Wildlife Act*. Globally it is considered secure. In the United States, it has a National Heritage Status rank of 'apparently secure'. In Canada, the Ancient Murrelet is Blue-listed (of special concern) by the British Columbia government and designated a species of Special Concern by COSEWIC.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for atleast 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.
** Formerly described as "Not In Any Category", or "No Designation Required."
*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
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SPECIES INFORMATION

Name and classification

The Ancient Murrelet (*Synthliboramphus antiquus)* belongs to the family Alcidae or the auks. The Ancient Murrelet is also known as 'Guillemot à cou blanc' in French and as 'skinkana' by the Haida of the Queen Charlotte Islands (Gaston 1992).

There are four species in the genus *Synthliboramphus.* The Ancient Murrelet's closest relative is the Japanese Murrelet, *S. wumizusume.* The two other species are the Xantus's Murrelet (*S. hypoleucus)* and Craveri's Murrelet (*S. craveri),* both of which breed in the Baja California region (Gaston and Jones 1998). Of these four species, only the Ancient Murrelet breeds in Canada (Gaston 1994a).

Description

The Ancient Murrelet is a small auk, about 25 cm long and weighing from 200 to 250 g (Gaston 1994a). The males and females look very similar, both having a yellow-tipped bill, black head, chin, nape and throat, with fine black-and-white lines where the black of the head meets the gray of the body. They have a white underbelly and their flight feathers are dark slate.

During the breeding season, the back, upper wing and upper tail coverts are dove gray; the head, throat, and sides are black, with the rest of the underparts white, except a sooty brown line dividing belly from underwing. A fringe of long, filamentous, white feathers, forming a slight crest (Gaston 1994a) rings the crown.

In the fall, Ancient Murrelets undergo a full moult into non-breeding plumage, similar to breeding plumage except that the throat is white with sooty smudges on the chin, the tonsure of white feathers is reduced and the mantle is greyer (Gaston 1992). This plumage does not last long; as early as December the birds have moulted back to their breeding plumage (Gaston and Jones 1998).

In the summer, the Ancient Murrelet can be distinguished from Cassin's Auklet (*Ptychoramphus aleuticus*) and the Marbled Murrelet (*Brachyramphus marmoratus*) by its black head and throat (Gaston 1994a). Immatures are similar to non-breeding adults (Gaston 1994a) except that they have no head streaks and have a white throat (National Geographic Society 1987; Gaston 1994).

DISTRIBUTION

Global range

Ancient Murrelets breed in a thin arc about 9,000 km in length around the northern rim of the Pacific Ocean (Fig. 1). The species becomes progressively more abundant

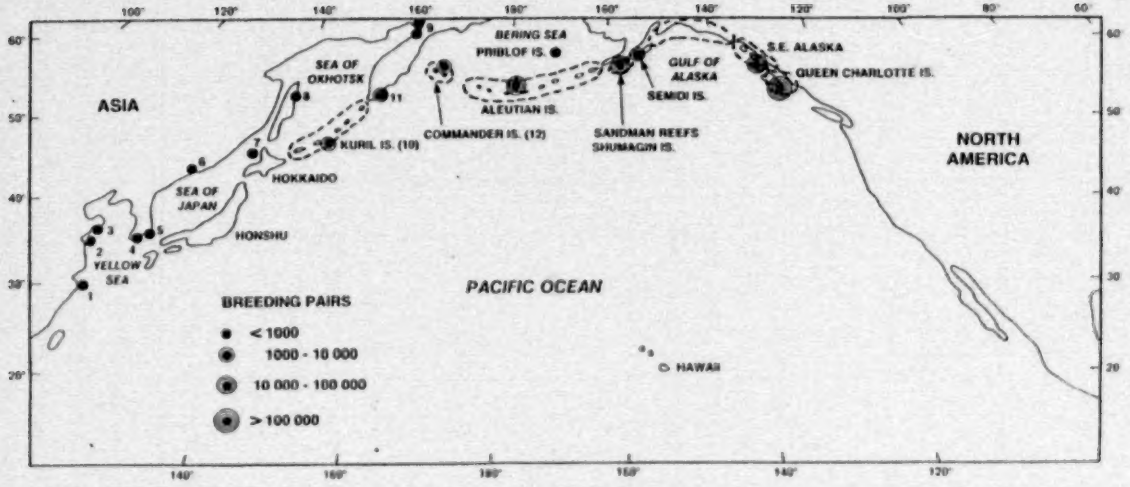

Figure 1. Global distribution of the Ancient Murrelet.

from China to British Columbia. Udvardy (1963) defined their distribution as "subboreal, pan-Pacific", similar to the Rhinoceros Auklet, *Cerorhinca monocerata*, and the Tufted Puffin, *Fratercula cirrhata*, which breed south to California in the eastern Pacific. In winter, the species spreads south as far as California and Taiwan (Gaston 1992).

In Asia, information about distribution and numbers of Ancient Murrelets is limited by the absence of survey work. Based on previous data collected, populations in China, Korea and Japan may be in danger of extirpation (Springer et al. 1993; Gaston 1994). There are probably no more than a few hundred pairs of Ancient Murrelets breeding in China, a few thousand on the Korean Peninsula, and a similar number around the coasts of the Sea of Japan. Approximately, 25,000 - 35,000 individuals breed in the Northern Sea of Okhotsk (Kondratyev et al. 2000), 13,000 individuals in Kamchatka (Kondratyev et al. 2000) and less than 2,000 in the Commander Islands (Kondratyev et al. 2000).

Ancient Murrelets also breed on several islands in Peter the Great Bay off Vladivostok, in discrete nesting areas. Shibaev (1987) estimated 500 pairs on Verkhovskii Island and in the same area, the species has been recorded breeding on Russkii, Karamzin (100 pairs in the 1960s) and Klykov islands, with an estimated the total population of 1,200 pairs (Litvinenko and Shibaev 1991).

The largest estimated Ancient Murrelet colony in the Asian part of the North Pacific is on Talan Island in Tauyskaya Bay where there are approximately 22,000 individuals (USFWS 2003). There is also an estimated population of 13,000 birds on Starichkov Island (USFWS 2003).

In Alaska, the species is common in the Aleutian Islands, Gulf of Alaska and the Alaskan Peninsula, though population estimates are incomplete. The population of this entire region is estimated at around 200,000 (USFWS 2003). The largest colony is at Forrester Island, SE Alaska, with approximately 60,000 individuals present in 1976. Other large colonies include Castle Rock in the Shumagins with 30,000 individuals in 1976. Several other islands in this vicinity are estimated to have over approximately 500 individuals. Hunt Island (1978), Koniuji Island (1982) and Buldir Island (1976) all have approximately 10,000 individuals (USFWS 2003). Chagaluk and Egg Island each had approximately 5,000 individuals in 1982 and 1980, respectively. The only other colony of any size is on St. Lazaria Island (1,500 birds in 1981) (USFWS 2003). During the winter, Ancient Murrelets disperse as far as California, arriving in late October (Ainley 1976).

Outside the Queen Charlotte Islands, there are only two definite records of Ancient Murrelets breeding in North America south of Alaska. Hoffman (1924) found a nest with eggs on Carroll Island, Washington, and a nest was reported in 1970 on an island in the Moore Group off the mainland coast of Hecate Strait, BC (Campbell et al. 1990). There have been no subsequent records from Washington, but small numbers are seen offshore and a fledgling was recorded in 1978. A very small breeding population may still exist there (Speich and Wahl 1989).

Canadian range

An estimated 256,000 pairs of Ancient Murrelets, about half the world breeding population, occur on 31 islands in the Queen Charlotte Islands (Rodway 1991; Gaston 1992; Vermeer et al. 1997, Fig. 2). Canada remains the only part of the species breeding range where population estimates are accurate to within orders of magnitude (Gaston 1994b). They are concentrated in two areas: off the west coast of Graham Island in the north, and off the east coast of Moresby Island in the south. The four colonies off Graham Island support approximately 49% of the breeding population, while the 17 colonies along the east coast of Moresby Island, mostly within Gwaii Haanas National Park Reserve, support about 44% of the breeding population (Lemon and Gaston 1999). There are also 10 colonies on the remote and rugged west coast of Moresby Island, which account for the remaining 7% (Rodway 1991).

The colonies off Graham Island have been known since the early 1900s, but no attempt was made to census them until 1981, although Spencer Sealy made a retrospective estimate of the size of the Langara Island colony for 1970-1971. Before that, only general statements such as "astronomical" (Beebe 1960), "immense numbers" or "thousands" (Drent and Guiguet 1961) were available. We have an even shorter record of the South Moresby colonies, which were unknown to outsiders until the 1960s, although familiar to the local Haida. For most Ancient Murrelet colonies in the archipelago, even orders of magnitude were uncertain until the 1980s.

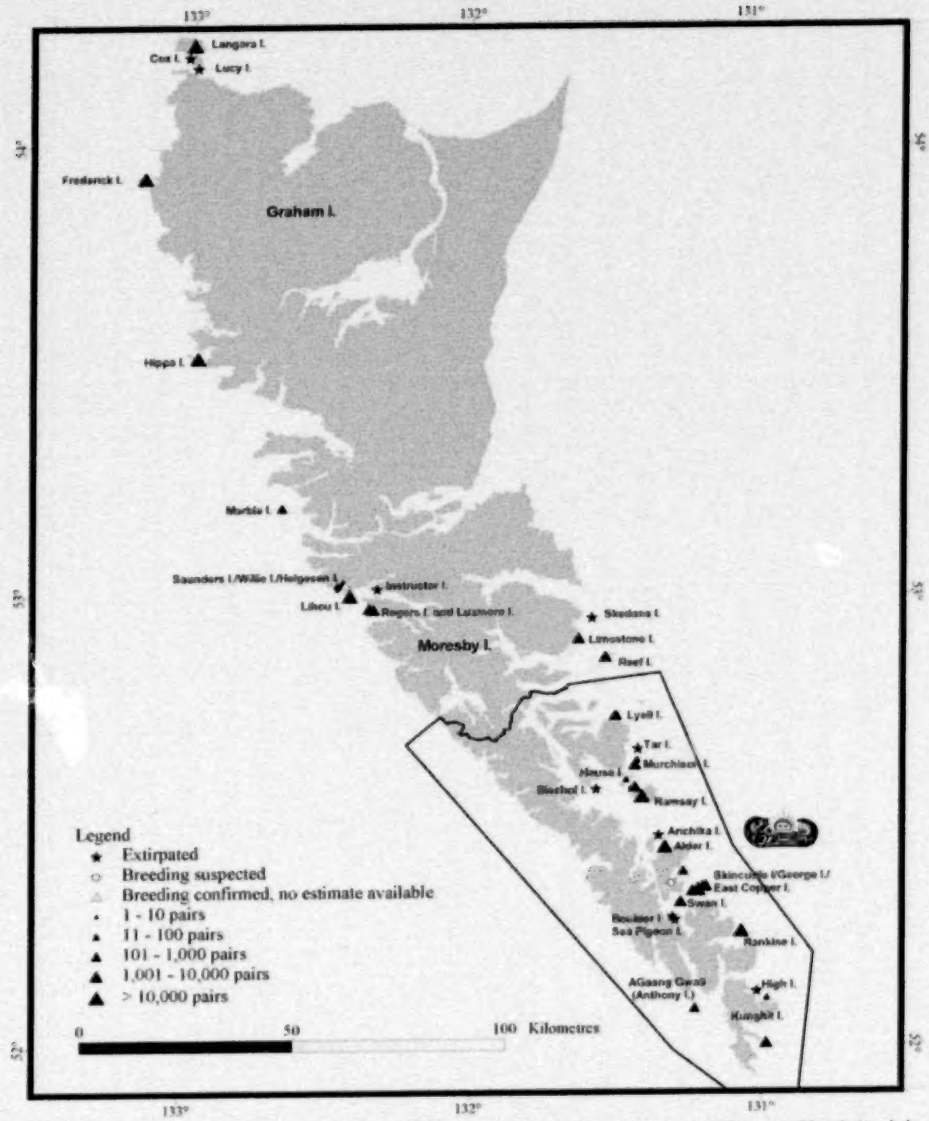

Figure 2. Locations and relative sizes of breeding colonies of Ancient Murrelets in the Queen Charlotte Islands (from Harfenist et al. 2002; data from Rodway 1988; Rodway et al. 1988, 1990; Harfenist 1994; Lemon 1997; Gaston and Masselink 1997; Gray 1999; Lemon and Gaston 1999).

Small numbers are also seen off the northern part of the west coast of Vancouver Island in summer and breeding may occur but remains unconfirmed. Family groups, including small chicks, are also sometimes seen in the southern part of the Queen Charlotte Islands (Smith and French 2000), because dispersal away from the breeding sites is very rapid (Duncan and Gaston 1990).

On Boulder and Sea-Pigeon Islands, in the inner part of the Skincuttle Inlet, Bristol Foster reported eggshells and the remains of dead adults in 1960 (Drent and Guiguet 1961), but by 1971 there was no sign of breeding (Summers 1974). Introduced raccoons are sometimes present on Boulder and Sea-Pigeon Islands (Rodway et al. 1988) and may have been responsible for the disappearance of Ancient Murrelets.

In 1971, Summers (1974) found abundant burrowing on Arichika Island and the Bischof Islands, and estimated 500 pairs were present at each location. This estimate was based on a combination of field records of abundance of burrows and proportions of islands covered by burrows, and sometimes by the amount of nocturnal activity. In 1985, Rodway et al. (1988) found no trace of these colonies.

HABITAT

Habitat requirements

Ancient Murrelets live mainly in subarctic waters where mean annual surface water temperatures are between 5 and 15 °C (Kitano 1981). They breed on islands between 20 and 2,000 ha in area (Gaston 1994b). Breeding sites are situated inland from the sea up to 300 m, rarely to 400 m (Rodway et al. 1988; Rodway 1990; Rodway 1994). This species does not coexist naturally with any terrestrial mammalian predators except river otters, *Lutra canadensis* (Gaston 1992).

In the Queen Charlotte Islands, SE Alaska, the Peter the Great Bay, and probably also in the Kuril Islands, Ancient Murrelets nest under forest canopy. Burrows are tunneled under the base of trees, stumps, or fallen logs (Gaston 1992) and may penetrate fissures in the underlying rocks (Drent and Guiguet 1961). On Frederick Island 79% of the burrows are under western hemlock (*Tsuga heterophylla*) (Vermeer et al. 1984). However, from Kamchatka through the Commander and Aleutian islands, and as far east as the Gulf of Alaska, Ancient Murrelet colonies are found on treeless islands (Gaston 1992). Where forest is available, it appears to be the species' preferred breeding habitat (Vermeer et al. 1984). Where it is absent, Ancient Murrelets usually pick the most densely vegetated area available. There may be many reasons for the choice of this habitat type, including stability of the soil for digging and this may be more significant than vegetative cover (Nettleship 2004 pers. comm.). On Buldir Island, in the Aleutian Islands they occupy the lowland tall-plant complex that grows to about 1 m high (Byrd and Day 1986). In the eastern Aleutians, the birds are found in *Elymus/ Calamagrostis* grassland and mixed *Elymus* and Umbelliferae. Burrows are also found in the foundations of abandoned native houses (Nysewander et al. 1982). Tussock grasslands are probably the birds main breeding habitat through much of their Alaskan range (Bendire 1895; Nysewander et al. 1982), but they also breed on small islands practically devoid of vegetation, and where they occupy rock crevices; the use of scree on islands off the Alaska Peninsula is common (Gaston 1994b).

Trends

There is no evidence that the Ancient Murrelet population is limited by the availability of breeding habitat, except at a few colonies where burrow density is high and all suitable habitat is occupied. In the Queen Charlotte Islands, they inhabit all but the largest islands of the archipelago because all but a few very small and exposed islets support coastal rainforest, their preferred habitat. Burrow density at colonies varies from high to low with some areas vacant that appear suitable for nesting (Rodway et al. 1988; Gaston, pers. obs.). Burrowing density decreases from south to north along the islands of southeast Moresby. Almost half the plots from colonies in the Queen Charlotte Islands had burrow densities below $0.33/m^2$ (G.W. Kaiser, unpublished data, in Harfenist 2003). Expansion of the colony on Langara after the removal of rats indicates that predators may limit population size at certain colonies (Drever 2002). Competition with Cassin's Auklets may occur in a few places where the species breeding habitats overlap (Vermeer et al. 1984) but is probably not an important limiting factor (A. Gaston, pers. comm.).

Habitat loss is a continual threat for most Ancient Murrelet colonies despite existing federal and provincial protection, including the recently created Wildlife Habitat Areas (see next section). The extent of the negative impact that human disturbance can have is seen in the case of a colony on southern Langara Island that appeared to be displaced when a fishing lodge was built (Vermeer et. al. 1997). Though an extreme example, these birds are at risk from any visitor activity that damages burrows or destroys their habitat (Harfenist et al. 2002).

Habitat protection/ownership

Sixteen of 31 Ancient Murrelet nesting colonies are protected under the *Canada National Park Act* in the Gwaii Haanas National Park Reserve, the southern part of the Queen Charlotte Islands (Fig. 3). One large colony off the west coast of Graham Island, Hippa Island, is a Provincial Ecological Reserve. Two other colonies, Reef Island and the Limestone islands, are protected as Wildlife Management Areas under the *BC Wildlife Act*. Two colonies (Lucy and Cox islands), where rats eradicated Ancient Murrelets, are on provincial crown land (Harfenist et al. 2002).

Under the Identified Wildlife Management Strategy (IWMS) of the BC Forest and Range Practice Act (formerly the BC Forest Practices Code), 11 Wildlife Habitat Areas have been approved for the protection Ancient Murrelet breeding colonies. These include Frederick, Helgesen, Marble, Luxmoore, Rogers, Sauders, Instructor, Lihou and Willie Islands (A. Hetherington, 2003, pers. comm.; info available http://wlapwww.gov.bc.ca/wld/identified/wha_areas.htm). Wildlife Habitat Areas designate important habitats in which activities are managed to limit their impact on the Identified Wildlife element for which the area was established.

Presently, there are no plans under the Canada Wildlife Act to create National Wildlife Areas in the Queen Charlotte Islands. However, there are 14 proposed 'Haida Protected Areas" of which the largest is Duu Guusd (Langara Island) (Harfenist et al. 2002).

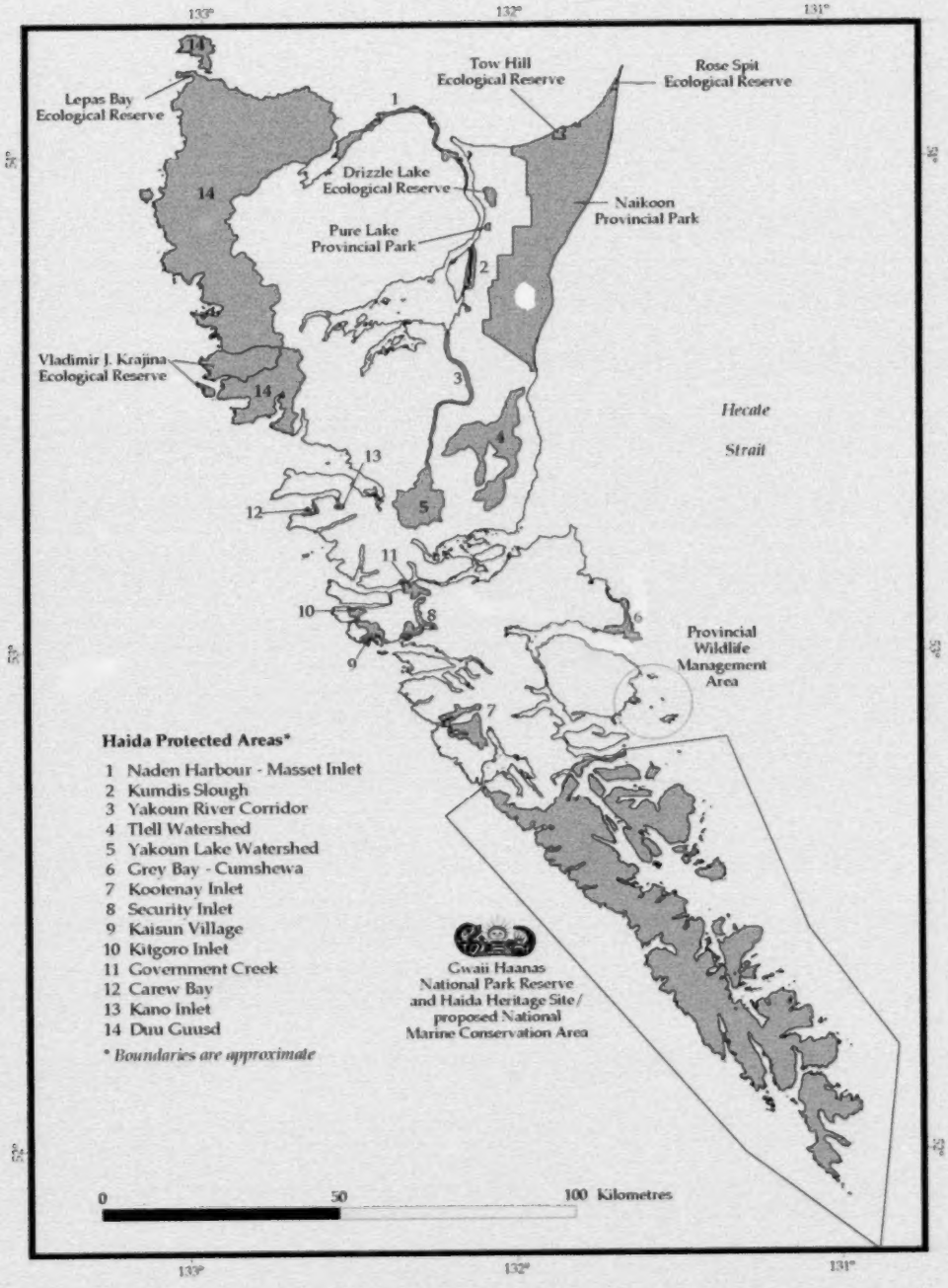

Figure 3. Location of Haida and federal protected terrestrial areas as well as provincial parks, ecological reserves and wildlife management areas in Queen Charlotte Islands (Harfenist et al. 2002).

BIOLOGY

General

The Ancient Murrelet is a small marine bird and is fairly generalized physically for an auk, having a bill that is neither specialized for fish nor plankton, and a functional morphology intermediate between specialized wing-propelled divers such as murres and the less specialized auklets (Gaston 1994a). It is unique in being the only seabird that has fully precocial chicks that go to sea without ever having been fed on the nest (Gaston 1994b). It also has a unique vocal repertoire that allows it to communicate effectively during its nocturnal colonial visits (Gaston 1994a).

Reproduction and Survival

In Canada, Ancient Murrelets breed only in the Queen Charlotte Islands. Timing of breeding varies across its range, with an observed 6-day delay in egg laying for every 1°C decrease in mean April sea-surface temperature near colonies (Gaston 1992). Generally, birds arrive at the colony in March with median clutch completion dates being between mid-April and early May (Gaston and Jones 1998). Timing of breeding varies between colonies and may be dependent on when the risks to adults from predation are least, and the availability of food for chicks is highest (Gaston 1997). Each breeding pair produces one clutch per year of 2 eggs each, 6 – 10 days apart, with no replacements (Gaston 1994a).

Ancient Murrelet parents share incubation duties equally (Gaston 1992) but do not feed their chicks before leaving the burrow. The chicks leave the burrow at night, 1-4 days after hatching (Sealy 1976; Shibaev 1978; Jones et al. 1990) and are raised entirely at sea (Litvinenko and Shibaev 1987). Parents feed the young for about 1 month, by which time they are fully grown and feathered (Litvinenko and Shibaev 1987).

Ancient Murrelets first breed at 3-4 years of age (Gaston and Jones 1998). Where there are no introduced predators, breeding pairs rear an average of 1.5 young per year to the stage of colony departure (Vermeer and Lemon 1986; Gaston 1992). Most family groups seen at sea after departure from their colonies are made up of two adults and two chicks. So, despite the precocial departure, survival of young during the first few days after deserting the nest site appears to be high (Gaston 1992). However, body condition and date of chick departure influences survival. Based on rates of recapture, chicks that leave the colony at 26 g or less (at any time) survive less well than heavier birds; birds leaving after the median date of departure survive best (Gaston 1997). Mean annual survival rate of adult Ancient Murrelets is 77%, relatively low for an alcid (Gaston 1990), but breeding success is high. Based on data from Reef Island, adult birds breed for an average of 4.5 years (Gaston 1994a).

Physiology

There is limited information on the physiology of Ancient Murrelets. However, there are traits common to alcids that provide some information. Auks store fat in a thin subcutaneous layer over much of the body, rather than in pockets as is the case in most

other birds (Gaston 1992). Auks also have heat exchange mechanisms in their legs (rete mirabile) to limit heat loss (Gaston 1992) and for their size, have high basal metabolic rates; an adaptation for keeping their bodies warm in colder climates. In order for auks to store oxygen while diving, they have a high blood volume and high levels of myoglobin (Gaston 1992).

Chicks are born at a mean weight larger than in other auks (15% of adult body weight versus 11%), with legs that are almost adult size. They also have very large fat stores at hatching (Duncan and Gaston 1988) used for energy reserves and possibly insulation. At hatching, chicks contain 13 g fat, but lose 40% of this before leaving the burrow (losing 2 g per day while in burrow). The remaining reserves are essential for the long, steady swim that they will have to undertake once they reach the water. What also helps the bird once they reach the water is their ability to thermoregulate immediately (Gaston and Jones 1998).

Movements/dispersal

Ancient Murrelets in Canada breed exclusively in the Queen Charlotte Islands off the British Columbia coast from April to June. Once breeding is complete, they leave the vicinity of their breeding colonies. Family groups from colonies in Hecate Strait remain in the Strait for several weeks (Duncan and Gaston 1990) while some appear off the Goose Islands in Queen Charlotte Sound during the same period (Guiguet 1953). By August, Ancient Murrelets are uncommon in Hecate Strait and in September they virtually disappear from British Columbia waters (Gaston 1992). Their movements during this season are unknown (Campbell et al. 1990; Gaston 1994). Large numbers of Ancient Murrelets appear in inshore waters off Vancouver Island by late October, where they remain until mid-February (Wahl et al. 1981; Campbell et al. 1990). A small number of birds move into the Bering Sea to winter, while others are known to remain within the Canadian breeding range (Gaston 1994a). Smaller numbers occur during the same season in waters out to the edge of the continental shelf off Washington, Oregon and California (Ainley 1976; Balz and Morejohn 1977; Briggs et al. 1987). By March, they appear in large numbers in Hecate Strait and begin visiting their colonies prior to egg laying.

Sightings of Ancient Murrelets have been recorded in Hecate Strait and the Queen Charlotte Sound in January and April through July, but not in September (Morgan 1997). They are present in Dixon Entrance in April and May; they have been reported in July, but are absent by October (Morgan 1997). Though it appears at times that most birds disperse south of the Queen Charlotte Island (Sealy 1976), some remain close to their colonies (Morgan 1997). Bird densities are highest during breeding season. The highest summer densities occur at the outer edge of the continental shelf, between Langara and Frederick islands. In the fall, sightings are restricted to the edge of the Shelf, west of Cartwright Sound, while winter sightings have been restricted to Hecate Strait, between Skidegate Inlet and Cape St. James (Morgan 1997). Ancient Murrelets are regularly sighted on Christmas Bird Counts in Masset and Rose Spit (Morgan 1997).

Visits by birds to other colonies do occur when colonies are close. Birds visiting non-natal colonies were found at Reef and East Limestone islands, located 6 km apart.

However there was no evidence that these birds were breeding on their non-natal island. Whether birds were also visiting Lyell Island, located 15 km from Reef Island and 20 km from East Limestone Island, could not be determined but it may be possible (Gaston and Adkins 1998).

Only one banding recovery of a Canadian Ancient Murrelet has been away from the Queen Charlotte Islands: a sub-adult/immature found dead on a beach in Washington State (Gaston 1994b). The origin of the birds that occur off southern British Columbia in winter is not known, but the large numbers involved suggest they are from the Queen Charlotte Islands.

Of all the alcids, the Ancient Murrelet is one of the species most prone to vagrancy (Gaston and Jones 1998). There have been sightings on lakes in the British Columbia interior and eight records from the Canadian Prairie provinces (Sealy et al. 2001). Several records also exist for the Ancient Murrelet in Mexico (Erickson et al. 1995) and Great Britain (Waldon 1994).

Nutrition and interspecific interactions

The diet of the adult Ancient Murrelet is made up primarily of large zooplankton and fish. Composition of the diets varies by season, age, location and availability (Sealy 1975; Vermeer et al. 1985; Gaston 1994). Before breeding in late March and early April, the birds are known to eat *Euphausia pacifica*, while *Thysanoessa spinifera* becomes a dominant part of their diet after breeding begins (Sealy 1975). Fish (including larval and juvenile fish) dominated the diet of the birds in June. Later in the season, they also feed on fish, primarily Pacific sand lance, (*Ammodytes hexapterus)* and rockfish (*Sebastes* spp.) but also flatfish (Pleuronectidae), juvenile shiner perch (*Cymatogaster aggregata*) and greenlings (*Hexagrammos* spp.) (Sealy 1975).

Information on winter diet is scarce. Gaston et al. (1993) found that the entire winter diet of Ancient Murrelets off southeastern Vancouver Island consisted of *Euphausia pacifica* (Harfenist 2003). In November, juvenile herring (*Clupea harengus*) dominated their diet.

There is also very little information on Ancient Murrelet chick diet. The stomach contents of 8 young collected at sea contained only sand lance (Gaston 1992). Results of an earlier study from Langara Island showed that the stomachs of subadults contained sand lance and euphausiids (Sealy 1975).

Behaviour/adaptability

While Ancient Murrelets can be found breeding in all types of forest, potential recolonization following forest destruction may take a long time (Gaston 1994b). At Limestone Island, a large area cleared by a wildfire was still not being used by murrelets 20 years later, although alder had regenerated strongly.

The reduction in area occupied by Ancient Murrelets at colonies on Langara and Lyell islands seems to be a response to heavy predation pressure by rats (Gaston 1994b). Recovery from such declines may require a critical number and density of active burrows to attract recruits. If that is the case, then recovery of extirpated colonies is unlikely, especially when population declines through the entire breeding range are common.

Pre-breeding birds have been trapped on islands other than their natal site, which suggests that some birds disperse away from their natal colony to breed (Gaston 1990). For instance, only 3% of pre-breeders trapped at East Limestone Island were banded as chicks, although about 50% of departing chicks were banded (Gaston 1990; Gaston and Adkins 1998). Subsequent DNA analysis at George and East Limestone Islands also suggests that birds move between colonies (Pearce et al. 2002). This ability to move between colonies may provide it with a mechanism to adjust to increasing pressure from human disturbance or predators, if appropriate habitat is nearby.

Finally, Ancient Murrelets are highly sensitive to disturbance at nest sites, causing pairs to abandon their burrow and eggs (Gaston et al. 1988). As pairs do not lay replacement eggs, the impact of abandonment is high and is considered the greatest cause of reproductive failure for these birds (Gaston and Jones 1998).

POPULATION SIZES AND TRENDS

Population declines have been observed at six colonies and eleven have been abandoned. Decreases have been observed on Langara, Lyell and Kunghit Islands because of introduced rats (Harfenist 1994; Bertram and Nagorsen 1995). Declines on Helgesen, Saunders and Limestone Islands have been attributed to raccoons, *Procyon lotor* (Gaston and Masselink 1997). Population increases of between 2.6% and 9.5% annually have been recorded on Reef, George, Ramsay and Lihou (Lemon and Gaston 1999, Table 1). Using data from colonies with surveys in both the 1980s and 1990s, an overall decline rate of approximately 18 percent over 10 years can be calculated.

Several small colonies in the southeast Moresby area have disappeared since the early 1970s. Murrelets were present on Low Island and the Skedans Islands in 1970, but were gone by 1983 (Summers 1974; Rodway et al. 1988). It is unlikely that either of these sites would have supported large populations because the islands are very small. Other colonies that have disappeared include Lucy, Cox, Instructor, Boulder, Sea Pigeon, Arichika, Bischof, Tar and High Islands (Rodway 1991).

Population estimates

There are an estimated 256,000 pairs of Ancient Murrelets nesting on 31 colonies in the Queen Charlotte Islands (Rodway 1991; Gaston 1992; Vermeer et al. 1997). The largest colonies are found on Frederick, George and Langara islands. Since the time that surveying began in the early 1970s, 6 colonies have decreased in size, 4 have increased, while 11 have been abandoned (Table 1, and section on Canadian range).

Though there is evidence that birds can move between colonies that are close together, there is no evidence that individuals in abandoned colonies moved to another location.

Changes in population size of colonies recently surveyed in the Queen Charlotte Islands are summarized below. Many islands have not been surveyed in nearly 20 years and therefore that information has not been included as it offers no additional insight into population trends. Estimates made on Reef, East Limestone, Langara, Ramsay and George islands are based on counts or estimates of burrow numbers; Lyell, George, Helgesen and Lihou islands are estimates of breeding pairs of birds. Data from Frederick Island are provisional, pending re-analysis of the colony area. Overall, recent increases of between 0.2 and 9.5% have occurred on all islands except on those where rats or raccoons are found (Lemon and Gaston 1999). All colonies with alien predators decline, often dramatically.

Langara Island

Based on early surveys, historic levels of the Langara Island population were estimated at approximately 200,000 birds (Gaston 1994b). In 1971, initial estimates indicated a population of between 80,000 and 90,000 breeding pairs. Subsequent studies found that the population had declined to 25,700 pairs by 1981 (Rodway et al. 1983) and 24,100 pairs in 1988 (Bertram 1989). The area occupied by Ancient Murrelets had also contracted between 1981 and 1988. These data indicate a dramatic reduction in population size of what was probably the largest colony in the Queen Charlotte Islands and perhaps in the world (Nelson 1990).

Earlier studies showed that the colony on Langara Island was not only declining, but also becoming more dense, from a density of 840 burrows/ha in 1981 (Rodway et al. 1983) to 1,358 burrows/ha in 1988 (Bertram 1989). Estimates of average density are obviously affected by the choice of colony boundary. For example, if some unoccupied areas are included, the density will be lower, but compensated for in the population size estimate by the increased area of the colony. However, a difference in where the colony boundary was does not explain the difference in density, because the mean density found by Bertram (1989) was greater than the maximum density found by Rodway et al. (1983). One reason for this increase in density may have been the presence of rats on the island.

Since the main rat eradication program was initiated on Langara Island in 1995, the population has not increased in size, though the colony area has expanded. By 1999, the breeding population had decreased from 14,630 ± 2,060 pairs in 1993, to 10,365 ± 2,011 pairs, but the difference was not statistically significant (Drever 2002). Preliminary analysis of 2004 data continues to show no statistically significant recovery for this population (Hipfner 2004, pers. comm.). However, in 1999, there was a significant decrease in burrow density (1,800 ± 160 burrows/ha to 765 ± 104 burrows/ha). There was also an increase in overall colony size from 22.9 ha in 1993 to 35.6 ha in 1999, with colony expansion towards the shoreline where the rats used to be

(Drever 2002). This supports the suggestion that the presence of the rats was influencing the burrow density in the colony. There may be other factors (e.g. changes in zooplankton production, mortality from commercial fishery) limiting the population on the island. (Drever 2002)

East Limestone Island and Reef Island

Studies of the Limestone Islands reveal that between 1974 and 1989, the population fell from an estimated 5,000 pairs (Summers 1974), to approximately 1,500 pairs (Rodway et al. 1988; Gaston et al. 1989). Only a small number of birds remained on the west island, occupying a small portion of the northeast corner. The population on East Limestone has either remained stable or decreased slightly (1% annual decrease) since the removal of the raccoons between 1985 and 1995, and presently (1999) is relatively stable (Gaston and Lemon 1996; Gray 2001). Reef Island, only 6 km away, experienced a population increase of 30% (annual increase of 2.9%) during that same time (1974-1989), based on census and chick-trapping results (Gaston and Lemon 1996). The presence of raccoons on East Limestone may explain the difference between colonies and may also explain the recruitment of Limestone birds to Reef Island (Gaston and Lemon 1996).

Rankine Islands

No discernable change in population has been noted on Rankine Island. The colony was surveyed in 2000, revisiting burrow density plots that had been set up in 1984. An analysis comparing the numbers of burrows in the plots in 1984 and 2000 revealed no change in numbers (M.J.F. Lemon, unpubl. data).

Frederick Island

Frederick Island was re-surveyed in 1998. There was a slight increase in population size, from 68,407 pairs in 1982 to 70,321 in 1998, an annual increase of 0.20% (M.J.F. Lemon, unpubl. data). There are no introduced predators on Frederick Island.

Other Islands

Introduced predators have caused reduction in populations on several islands, including Langara (rats), Helgesen (raccoons; annual decrease of 23% (Gaston and Masselink 1997), and may have caused the extirpation on others. The presence of rats has caused populations on other islands, such as Kunghit and Lyell, to decrease dramatically or disappear altogether, Kunghit Island experienced a decrease in colony size from 44.2 ha to 11.1 ha between 1986 and 1993 (annual decrease of 18%, Harfenist 1994, Bertram and Nagorsen 1995), and it now appears that the population was extirpated by 2004, (Hipfner 2004, pers. comm.). On Lyell Island, the population decreased from 10,656 burrows in 1982 to 8,332 in 1992 (25% decrease, or 2.5% per annum) with a 30% decline in colony area (Lemon 1993a). The impacts of predators

appears to be long-lasting, as the populations on Helgesen, Little Helgesen and Saunders have shown no signs of recovery since raccoons were exterminated in the mid 1990's (Hipfner 2004, pers. comm.).

On islands with no introduced predators, there has been an annual increase in population of between 0% and 9.5% (Lemon and Gaston 1999). Annual increases of 9.5% were seen on Lihou Island between 1986 and 1993 (Gaston and Masselink 1997), an island with no introduced predators, and this population continues to remain stable today (Hipfner 2004, pers. comm.)Some of these population increases may represent a shift in the distribution of birds away from islands with alien predators (Harfenist et al. 2002).

Monitoring Plots

In 1985 and 1986, Canadian Wildlife Service (CWS) field crews set up permanent monitoring plots on several Ancient Murrelet colonies in the Queen Charlotte Islands, including George and Ramsay Island. The plots were mapped and clearly marked on the ground and the numbers of burrows counted:

George Island - Number of burrows in 8 monitoring plots increased from 258 burrows in 1985 to 327 in 1991, an increase of 27%. In 1996, a total of 367 burrows were present, a further 12% increase (Lemon 1997). Overall, the population is estimated to have increased from 11,614 pairs in 1985 to 17,384 in 1996, an annual increase of 3.7% (Lemon and Gaston 1999).

Ramsay Island - A 1992 survey of the 1985 plots showed that burrow numbers on 11 monitoring plots had also increased (Lemon 1993b). A survey in 2002 showed an overall increase of 58% between 1984 and 2002 (M. Hipfner unpubl. data). These data indicate that the numbers of Ancient Murrelets are increasing in the Gwaii Haanas area. Both George and Ramsay Islands have no introduced predators.

LIMITING FACTORS AND THREATS

The populations of Ancient Murrelets in Canada continue to be under pressure for many reasons. Major factors responsible are outlined below.

Introduced predators

The main factor limiting populations in the past century has been the introduction of mammalian predators to island colonies including rats and raccoons in British Columbia. In Canada, rats are considered an important predator of Ancient Murrelets (Drever and Harestad 1998). They have been recorded on 18 islands in the Queen Charlotte Islands (Bertram and Nagorsen 1995) including four with breeding populations of Ancient Murrelets: Kunghit, Lyell, Langara, and Murchison islands (Bertram and Nagorsen 1995). Rats are responsible for declines or extirpation of

colonies on Kunghit, Lyell, Langara, Cox, Lucy, Murchison and Bischof islands (Harfenist and Kaiser 1997). For example, in 1992, 50% of occupied burrows on Lyell showed evidence of rat predation (Lemon 1993a) and the 90% decline in the murrelet population on Langara is thought to be the result of rat predation (Bertram 1995). Although rats have now been eradicated on Langara, with none detected since 1996 (Taylor et al. 2000), recolonisation could occur through commercial and pleasure boats (Bertram and Nagorsen 1995).

Another threat to Ancient Murrelets is raccoons. Raccoons have been previously reported from several of the islands with breeding colonies (Helgesen, Limestone, Ramsay, Skincuttle, Saunders and George), but are now found only on Alder islands (Bertram and Nagorsen 1995; Harfenist and Kaiser 1997; Harfenist 2002; Harfenist unpublished data, A. Gaston, pers. comm.; Hipfner 2004, pers.comm.). Raccoons can cause substantial losses to seabird colonies and are likely responsible for declines recorded on Limestone, Saunders and Helgesen islands. For example, in 1991, three adult raccoons on East Limestone Island killed at least 11% of the breeding population of Ancient Murrelets and reduced the number of chicks leaving the colony by 35% (Gaston 1991; Gaston 1992). Following the removal of raccoons during in 1992, the numbers of Ancient Murrelet chicks produced increased by 20%, and adult mortality decreased by nearly 80% (Gaston and Lawrence 1993). Similarly, the population of Ancient Murrelets on Helgesen Island declined by 80% over 7 years when 8-12 raccoons were present (Gaston and Masselink 1997).

Although raccoons have been eradicated from a number of the islands (Helgesen, Little Helgeson, Saunders, E. and W. Limestone) about half of the colonies in the Queen Charlotte Island are vulnerable to invasion (Lemon and Gaston 1999; Hipfner 2004, pers.comm.).

Oceanographic changes

There is some evidence that oceanographic changes could have long-term impacts on Ancient Murrelet populations. A recent comparison between changes in oceanographic conditions and inter-annual changes in breeding biology of Ancient Murrelets in Hecate Strait between 1983 and 1999 showed that long-term changes in ocean conditions could have an impact on the health of the population (Gaston and Smith 2001). Correlations were found between sea-surface temperature and Southern Oscillations as well as mean number of chicks departing per breeding pair and chick departure mass.

Oil exploration

The recent decision by the Federal government (initiated by a request from the BC provincial government) to review the moratorium on offshore oil and gas exploration in the Queen Charlotte Basin, specifically in Hecate Strait, is a potential threat to the Ancient Murrelet. If lifted, the exploratory drilling and eventual increase in shipping activity and oil transport (tanker or pipeline) will significantly increase the possibility of

catastrophic oil spills in the region. There may also be an increase in nighttime mortalities due to collisions with lines near oil platform lights (Montevecchi et al. 1999). Ancient Murrelets have been heavily impacted by spills in other regions (Harfenist 2003) because oil spills are a particular threat to species that congregate in one area (Harfenist et al. 2002). This might also increase what is a continual threat to these birds—small, low-level spills from ships moving through the region (Harfenist and Kaiser 1997).

Commercial fisheries

By-catch of seabirds continues to be a threat to populations in the Queen Charlotte Islands. Estimates suggest that 25,000 seabirds may be killed annually in fishing gear off the British Columbia coast (Morgan et al. 1999). Ancient Murrelets have been caught in gill nets near Langara Island. Fisheries may have been the cause of the large, early decline in this population in the 1950s and 1960s, and may continue to play a part in the health of Ancient Murrelets on Langara (Bertram 1995). Overfishing of Ancient Murrelet prey species may also have a negative impact on this species (Harfenist et al. 2002).

Disturbance

Disturbance of nesting or feeding birds by tourists or other human activity in the region where Ancient Murrelets are found is a continual concern. Recreational boating and camping can damage habitat or injure chicks or adults (Harfenist et al. 2002). Lights around campsites and on boats are known to disorient birds during nights with low overcast and fog (Harfenist et al. 2002, A. Gaston, pers. comm.).

Logging

Forestry activities could directly affect Ancient Murrelet breeding activities by reducing habitat quality, both through removal of the forest canopy preferred by the birds and through compaction of soil, making burrowing difficult. Logging has been suggested as a confounding variable in the lack of recovery at the Langara Island colony (M. Chutter, pers. comm. 2004).

SPECIAL SIGNIFICANCE OF THE SPECIES

The Queen Charlotte Islands support about half of the world's population of Ancient Murrelets (Gaston 1994b). The Haida of the Queen Charlotte Islands harvested Ancient Murrelets at least into the 1960's (W. Campbell, 1992, pers. comm., in Gaston 1994b) and the birds have some cultural significance (Gaston 1994b).

The Ancient Murrelet has also become the "flagship" of conservation efforts in the Queen Charlotte Islands, especially by the Laskeek Bay Conservation Society, which continues to encourage eradication or control of introduced animals in the archipelago.

EXISTING PROTECTION OR OTHER STATUS

The adult, nests and eggs of Ancient Murrelets, are protected by the *Migratory Birds Convention Act (1994)*. However, members of the Haida can still legally hunt murrelets, as the bird was a traditional food source. Under the *Canada National Marine Conservation Areas Act (2002)*, the Ancient Murrelet is protected in its "sea space" and has listed status. It is also protected from killing and wounding, taking and transporting under the *BC Wildlife Act*.

Eleven breeding colonies are currently protected as Wildlife Habitat Areas under the Forest and Range Practices Act of BC. Also, the Haida Nation is working with Parks Canada on management issues in the Queen Charlotte Islands, including those involving the Ancient Murrelet (G. Goulet, 2003, pers. comm.; Captain Gold, Archipelago Management Board, 2003, pers. comm.).

Globally, the Ancient Murrelet has a Global Heritage Status rank of G4, or 'globally secure'. It is not listed under CITES, nor is it listed in the IUCN Red book. In the United States, the Ancient Murrelet has a National Heritage Status rank of N4B, N4N (apparently secure). It is ranked in Alaska as S4 (apparently secure and in Washington as S3S.

In Canada, it has a National Heritage Status Rank of N3 or vulnerable. It has a Heritage Status Rank in BC of S2S3B, S4N and is also Blue-listed (of special concern) by the BC Provincial government.

TECHNICAL SUMMARY

Synthliboramphus antiquus
Ancient Murrelet
Range of Occurrence in Canada: BC

Guillemot à cou blanc

Extent and Area information	
• *extent of occurrence (EO)(km²)* in Canada	200,000 km² nonbreeding 30,000 km² breeding
• *specify trend (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)* (adult feeding range = coastline of existing colonies with a buffer of 20 km; estimated coast line of 300 km)	6,000 km²
• *specify trend (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	No
• *number of extant locations*	31
• *specify trend in # locations (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Number of colonies remains constant; area of colonies declining where predators present
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	About 7-8 years
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	512,000
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	decreasing
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	About 18% from 1980s to 1990s at censused colonies
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	No
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	No; exchange between colonies in the Queen Charlotte Islands
• *list each population and the number of mature individuals in each*	Not applicable
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Not applicable
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	Not applicable
Threats (actual or imminent threats to populations or habitats) [add rows as needed]	
- Introduced mammalian predators; rats or raccoons (primary threat) - Disturbance and habitat destruction - Oil exploration - Oceanographic changes - Competition/impact commercial fisheries	

Table 1. Census and monitoring of Ancient Murrelet populations in the Queen Charlotte Islands (Lemon and Gaston 1999).																	
Colony census	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1988**	**1989**	**1991**	**1992**	**1993**	**1995**	**1996**	**1998**	**Annual change**	**References**
Reef I.*						7845							10465			2,90%	Gaston and Lemon 1996
East Limestone I.*				2376					2850				2122			-1,00%	"
Dodge Pt., Lyell I.			10656								8332					-2,25%	Lemon 1993a
George I.						11614								17384		3,70%	Lemon 1997
Langara I.*		82650						63150				41220				-6,60%	Harfenist 1994
Frederick I.	68407														70321	0,20%	Lemon, unpub.
Helgesen I.							6804					1139				-23%	Gaston and Masselink 1997
Lihou I.							6452					12140				9,50%	"
Kunghit I.+							44,2					11,1				-18%	Harfenist 1994
Monitoring plots																	
Ramsay I.*					206						252					2,60%	Lemon 1993b
George I.*						258				327				367		3,30%	Lemon 1997

* Counts or estimates of burrows: other figures are breeding population estimates in pairs of birds, except (+), colony area in ha.
Numbers for Frederick Island in 1998 are provisional, pending reanalysis of colony area.
Data from 1980 - 1988 for whole colony censuses are from Rodway et al. 1988, 1990 and 1994.
All estimates suggest increases ranging from 0,2 - 9,5% annually except where there are/were rats (Langara, Lyell, Kunghit), or raccoons (East Limestone, Helgesen).

Rescue Effect (immigration from an outside source)	Moderate
• *does species exist elsewhere (in Canada or outside)?*	Yes
• *status of the outside population(s)?*	Uncertain, but likely declining in Alaska and Asia
• *is immigration known or possible?*	Probable
• *would immigrants be adapted to survive here?*	Yes
• *is there sufficient habitat for immigrants here?*	Yes, but introduced predators may be limiting available breeding sites
Quantitative Analysis	Not done
Current Status **COSEWIC: Special Concern**	

Recommended Status and Reasons for Designation

Recommended Status: Special Concern	
Reasons for Designation: This is a ground nesting seabird threatened by mammalian predators that have been introduced to its breeding islands. Predators have been removed from some islands but populations have not increased as a result. About half of the world population nests in the Queen Charlotte Islands, British Columbia; the Canadian population is thought to be declining.	
Applicability of Criteria **Criterion A** (Declining Total Population): not applicable; current declines poorly measured and unlikely to be large enough **Criterion B** (Small Distribution, and Decline or Fluctuation): not applicable; distribution too large **Criterion C** (Small Total Population Size and Decline): not applicable; population too large **Criterion D** (Very Small Population or Restricted Distribution): not applicable; population and area of occupancy both too large **Criterion E** (Quantitative Analysis): not done.	

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